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Original Article

The Nurse–Nurse Collaboration Behavior Scale: Development and psychometric testing

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ABSTRACT

Objective: To develop and test the reliability and validity of a new instrument, the Nurse–Nurse Collaboration Behavior Scale (NNCBS).

Background: The importance of cooperation among nurses is widely acknowledged, but is a lack of scientific studies regarding the behaviorial interactions associated with nurse–nurse relationships throughout the process of patient-centered care. Therefore, there is a great need to develop a reliable scale to measure nurse–nurse collaboration behavior, which is what we have generated in this study.

Methods: The 46-item Nurse–Nurse Collaboration Scale was developed using a process of item design, refinement, and testing for both reliability and validity. In 2014, the 202 nurses from the International Department of Services participated in this pilot study. Cronbach's a coefficients and test–retest reliability coefficients were calculated in order to evaluate this new scale's internal consistency and stability. Exploratory factor analysis was calculated using a principal factor method with promax rotation to evaluate the scale's validity.

Results: Exploratory factor analysis yielded four factors and 23 items. The overall Cronbach's a coefficient of the scale was 0.929. The item-total correlation values were overall high, ranging from 0.427 to 0.751. For the entire scale, the r values of the test–retest reliability correlations were 0.764.

Conclusion: The NNCB Scale developed in this study demonstrates acceptable reliability and validity for measuring the level of NNCB. Its implementration on a broader scale would at the very least guide and promote collaborative relationships between nurses involved in patient care. It should be noted that the scale requires further psychometric testing using a larger sample size of nurses who also represent a wider diversity of backgrounds, as well as researchers who are encouraged to improve the instrument.

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[1] Chuli Liao wrote the draft and Ying Qin guided the whole process of the study.
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1. Background

Numerous studies have reported that there is a widespread occurrence of medical errors during drug administration, which ultimately causes a rise in adverse drug effects. These errors can be primarily attributed to inadequate team-work, poor communication and weak interpersonal interactions [1–5]. A dramatic improvement in communication, the transmission of information, effective decision-making, a deeper demonstration of respect for the roles of nurses, as well as collaboration and teamwork among both nurses and physicians have been reported to be associated with reduced medical errors, increased nurse job satisfaction and improved patient safety [6–13]. The healthcare institutions in both Europe and the United States are trying to improve the quality of patient care by strengthening the collaboration among healthcare professionals [7,8]. The Chinese healthcare reform that focuses on client-centered care puts a great emphasis on collaboration, considereing that critical decisions are forced to be made in a limited amount of time. In addition, patient needs continue to expand in number and diversity without a simultaneous increase in staff number. Nurse/physician collaboration is studied worldwide, however collaboration among nurses alone has not been thoroughly investigated. Since nurses are physically present with patients to a greater degree than any other clinician, they are in a unique position to both assess patient responses to therapies and then communicate those changes in order to ensure the most appropriate therapy is being administered. Nurses are provided with a large portion of the responsibilities during patient care. Therefore, collaboration and strong communication among nurses is critical to maintaining a safe and effective therapeutic environment for patients.

Collaboration and teamwork among nurses have been identified as an indication of nursing ability, and therefore increasing the level and quality of collaboration among nurses will greatly improve the work environment and facilitate an improvement in patient safety and health improvement [14,15]. Inadequate communication and collaboration have been identified as primary contributors to medical error, adverse events, operative and postoperative complications, and treatment delays. Studies have reported that poor interactions, withholding support, lack of coordination, tension and intimidation are prevalent among nurses [5,16]. This perceived hostility among nurses is largely due to more experienced nurses being thought of as "bitchy and cliquey", since most of the more inexperienced nurses have reported being verbally abused by the superior nurses [17,18]. The conflicts among nurses may also result from organizational constraints, leadership style, inadequate interpersonal relationships and violence among social equals who consider themselves powerless [5,17–19].

Research in both Europe and the USA has focused on self-report measurements of collaboration among nurses and physicians. While there are numerous instruments to measure nurse–physician collaboration, there is only one current instrument that measures collaboration among nurses, whereas others that are related to nurse collaboration are either a component of an organizational appraisal instrument or a subdomain of a larger construct measured by only four or five questions [23,24]. The Nurse–Nurse Collaboration Scale, developed by MB Dougherty, measures organizational climate with a focus on communication, coordination, problem-solving and conflict management. These categories come from the ICU Nurse–Physician Questionnaire (ICUN-P-Q) that was developed by Shortell [23,25]. The Nurse–Nurse Collaboration Scale measures the overall nurse attitude toward cooperation climate by measuring each nurse's self-assertiveness towards each other, however it does not measure specific behaviors associated with nurse–nurse relationships in the process of patient-centered care. Therefore, it is clear that there is a true need to develop a scale to thoroughly and accurately measure nurse–nurse collaboration behavior.

This article reports the development and psychometric testing of a new instrument, the Nurse–Nurse Collaboration Behavior Scale (NNCBS), that will serve to analyze factors that promote collaboration and improve collaborative system planning.

2. Methods

2.1. *Definition of nurse–nurse collaboration behavior*

The concept of nurse–nurse collaboration behavior is based upon the current definition of nurse–physician collaboration. Henneman interpreted "collaboration" as a cooperative venture based on shared values such as the concern and respect for others, performance goals, and commitment on the part of all parties involved [20]. Baggs and Schmitt emphasized the importance of the development and maintenance of collaboration, which requires shared decision-making, working together cooperatively, open communication and coordination during planning and implementation of care [21]. Stapleton believed the autonomy within her scope of practice and power that were based on knowledge and experience are two more essential attributes of collaboration [22]. The definition of collaboration between nurses and physicians will serve as the basis for the development of the definition of nurse–nurse collaboration behavior. This term will be defined as any actions of communication, coordination, professionalism, and conflict management that are upon common goals, mutual trust and respect. These domains were adopted as a framework for our study.

2.2. *Instrument development*

The NNCBS was devised by a process that consists of item design, item refinement, as well as the testing for both reliability and validity.

2.2.1. *Item design*

Items were designed based on a sequential process that consisted of literature review, observation of nurse collaboration within the ward and key-informant interviews of 15 nurses by means of a semi-structured format. These nurse subjects work in either internal medicine, surgery, the ICU, Emergency,

or the pediatrics department, and each was in a different ranking of professional qualification. The interviews were designed to: (1) clarify their interactions while providing patient care, (2) determine the methods used for conflict management when opinions differed. This initial scale was identified based on literature review, observation and interviews. The initial resulting scale contained 46 items. Respondents were asked to rate each behavior based upon a 5-point scale; (1) Always, (2) Usually, (3) Sometimes, (4) Rarely and (5) Never. The specific instructions were: "The purpose of this scale is to determine the extent of collaborative behaviors that generally exist among nurses when providing patient care. For each statement, please check the box that indicates the frequency with which each behavior occurs. Please answer each item to the best of your ability."

2.2.2. *Refinement*

To refine the 46 items in the scale and ensure their validity, the content of each item was examined by two nursing managers and two nurses with master degrees from Peking Union Medical College Hospital. In addition, we also recruited the input of one nursing faculty from Peking Union Medical College who was proficient in interprofessional research and collaboration. Each domain item was evaluated as (1) not relevant, (2) unable to assess relevance without item revision or item in need of such extensive revision that it would no longer be relevant, (3) relevant but requires minor alterations, and (4) very relevant. Experts agreed on each item by using a rating of 3 or 4. Each expert agreed that the individual items assessed the essential components of collaboration, with the exception of three items that failed to correspond with the whole construct of the collaboration. Three experts indicated that the item "the nurses show concern and respect for each other" was ambiguous and that the other two items, including "the nurses are willing to collaborate" and "I complete my job on my own" were ambiguous and did not describe specific actions. They further indicated that the precision and simplicity of words used in 12 of the items required modifications and the appropriate refinements were then made. The final 43 items were obtained. Two nurses responded to the questionnaire and it took them approximately five minutes to complete.

2.3. *Participants*

In July 2014, a total of 202 nurses from the International Department of Services participated in this study. Both individuals who had left their post and clinical managers were excluded. Eligibility criteria included 18 years or older, ability to both speak and write Mandarin, two or more years of clinical experience and willingness to participate. Of the 202 nurse participants, 199 were female, three were male and all were clinical practitioners.

2.4. *Data collection*

This study proposal has been approved by the Ethics Committee of the Peking Union Medical College Hospital, which is where the study was performed. The questionnaires were sent to the individuals in charge of each ward and were distributed to the nurses for completion. Consent to participate was assumed based upon a preliminary questionnaire, which did not contain any personal information that could be used to identify the respondent. Test-retests were performed in a ward of 24 nurses who gave their consent to undergo retesting, with each participant assigned a number to maintain anonymity. A small gift was provided as compensation.

2.5. *Data analysis*

Data were analyzed using SPSS 16.0 statistical software. Cronbach's a coefficients and test–retest reliability coefficients were calaculated to evaluate the scale's internal consistency and stability. Alpha coefficients were also calculated for item-total (I–T) correlation and for item elimination. When Cronbach's coefficients of the item-total correlations were compared with those obtained when an item had been eliminated, the item that didn't lower the coefficient value was accepted. When the coefficient between two items was 0.7 or above, which fell within the cutoff range and therefore indicated acceptability, deletion or retention of the item was considered. When the correlation coefficient fell above 0.8, this indicated high correlation among them and one of them was subsequently deleted. In addition, items with low correlation coefficients were considered for retention [26]. Exploratory factor analysis was calculated using a principal factor method with promax rotation to evaluate the scale's validity.

3. Results

Questionnaires were returned by 202 nurses with a response rate of 95.05% and a resulting total of 192 valid questionnaires. The participants were mainly women (97.8%), the mean age of the participants were 28.41 ± 6.24. Of the participants, 55% had earned a bachelor's degree and 60.3% were married. Additionally, 39.7% had 0–5 years of nursing experience, 40.3% had 5–10 years of experience and 20% had more than 10 years of experience. Furthermore, 21.4% were from the surgery department, 25.8% were from the internal medicine department, 30% were from the obstetrician and genealogist department and 22.8% were from the emergency department and ICU.

3.1. *Correlations between items and no response items*

During this process, two of the survey items were deleted due to their high correlation coefficients. These included "the nurses discuss how to deal with the situation when confronting a difficult patient" and "the nurses think about each other".

3.2. *Exploratory factor analysis*

The remaining 41-item scale was analyzed using exploratory factor analysis (principal factor method, promax method), and 18 items were deleted due to low factor loading (0.4 below) or because they did not belong to any factors. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test illustrated that the data were

appropriate for factor analysis (KMO index = 0.759, $\chi^2 = 997.19$, $P < 0.001$).

Principal component analysis using varimax rotation identified four factors with eigenvalues greater than 1 and a factor loading equal to or greater than 0.4, which accounted for 66.06% of the variance observed. Four factors and 23 items were yielded: conflict management (5 items), communication and coordination (7 items), professionalism and autonomy (8 items), and common goal (3 items), as shown in Table 1.

3.3. *Reliability*

Cronbach's a coefficients were carried out once again to evaluate the scale's reliability. Cronbach's a coefficient for the scale was 0.929. Cronbach's a coefficients were 0.859 for conflict management, 0.884 for communication and coordination, 0.787 for common goals, and 0.882 for professionalism and autonomy. The total item correlation values were high, ranging from 0.427 to 0.751. No items were dropped due to lowering of the coefficient value when Cronbach's a coefficients of the total item correlations were compared with those obtained once an item had been eliminated.

The test–retest method was analyzed to assess stability. The test–retest correlation coefficients were 0.764 ($p < 0.05$) for the whole scale, 0.747 ($p < 0.05$) for conflict management, 0.687 ($p < 0.05$) for communication and coordination, 0.654 ($p < 0.05$) for professionalism and autonomy, and 0.794 ($p < 0.05$) for common goals.

Table 1 – Nurse–Nurse Collaboration Scale items, factors, and descriptive statistics (n = 192)

Factors and items	Mean ± SD	Factor loading	item-total correlation
Conflict management (accounting for 15.491% of variance, Cronbach's a coefficients: 0.859)			
1. In the event of a disagreement or conflict, everyone's feelings and points-of-view are considered in order to arrive at the best possible solution.	4.48 ± 0.660	0.776	0.528
2. In the event of a disagreement or conflict, all nurses work together to arrive at the best possible solution to the problem.	4.54 ± 0.631	0.823	0.527
3. All nurses reach an agreement on the best possible solution to the disagreement or conflict at hand.	4.29 ± 0.780	0.885	0.427
4. All nurses try to avoid conflict.	4.66 ± 0.514	0.659	0.455
5. Any conflicts or disagreements among nurses are resolved quickly and peacefully.	4.45 ± 0.630	0.652	0.525
Common goals (accounting for 6.936% of variance, Cronbach's a coefficients: 0.787)			
6. Group discussion meetings are held to solve issues regarding patient care.	4.32 ± 0.789	0.608	0.594
7. All nurses reach an agreement regarding specific goals for the patient's pain management.	4.57 ± 0.568	0.690	0.660
8. All nurses reach an agreement regarding the patient's safety goals.	4.68 ± 0.508	0.850	0.730
Communication and coordination (accounting for 25.892% of variance, Cronbach's a coefficients: 0.884)			
9. All nurses speak directly and objectively to each other regarding the patient's care.	4.54 ± 0.602	0.760	0.619
10. The action among nurses is carried out regularly in emergency situation.	4.64 ± 0.520	0.660	0.605
11. In the event that a patient distrusts or expresses doubts regarding specific nursing practices, nurses attempt to respond to the patient in a respectable and consistent manner to quickly resolve the situation.	4.70 ± 0.537	0.861	0.684
12. The nurses share information with patients about the nursing protocol that is either ongoing or already done.	4.68 ± 0.508	0.832	0.646
13. The nurses share information regarding any changes in current treatment plans for the patient.	4.66 ± 0.514	0.634	0.660
14. The nurses share information with each other regarding a patient's reaction to descriptions of his/her disease status and treatment methods.	4.55 ± 0.685	0.567	0.742
15. When a nurse takes charge of a patient suffering from much more serious disease or takes more workload, the other nurses will help her.	4.77 ± 0.467	0.608	0.552
Professionalism and autonomy (accounting for 18.083% of variance, Cronbach's a coefficients: 0.882)			
16. My ideas regarding the goals and direction of patient care are respected and considered.	4.32 ± 0.716	0.776	0.696
17. Nurses avoid the use of procedures that violate aseptic principles.	4.59 ± 0.596	0.581	0.554
18. I have input regarding my desired shift.	4.29 ± 0.868	0.748	0.474
19. I make decisions about how to do with my work.	4.05 ± 0.840	0.808	0.612
20. I have influence on what happens during my patient's care.	4.38 ± 0.702	0.602	0.669
21. The nurses adequately understand the treatments and drugs they are providing for each patient.	4.43 ± 0.710	0.710	0.586
22. I stay closely attuned to the progress of my patient's condition and am always prepared to adapt to unforeseen changes.	4.30 ± 0.630	0.735	0.546
23. Nurses avoid the use of procedures that compromise patient safety.	4.61 ± 0.493	0.759	0.553

4. Discussion

Most measurement scales for "cooperation" have been developed to focus primarily on interactions and relationships. These scales measure the natural features of an organization that emphasize individual human relations. The measurement scales developed in the present study, on the other hand, include discussion, problem-solving and professional autonomy elements among nurses regarding patient care. The instrument items describe more specific actions and may provide guidance for promoting collaborative relationships among nurses.

Our findings demonstrate that the NNCB Scale is a valid, reliable instrument, which is supported by high internal consistency and strong construct validity. The scale showed evidence of acceptable reliability with high internal consistency achieved. The total item correlation ranged from 0.427 to 0.751 with regard to the whole scale, indicating that the corresponding item is measuring the same construct with no indication of item redundancy. All results for test–retest reliability were satisfactory, strongly suggesting that the NNCB Scale is reliable.

Four factors were derived from the NNCB Scale as a result of the exploratory factor analysis nurses, which demonstrated that the nurses are aware that they collaborate in the wards using common goals, conflict management, professional interactions and cooperation. The subconstruct "professionalism and autonomy" reflects nursing behavior that directly asserts that the nurses have professional expertise and professional opinions about patient care. We centered on the nurses' unique contributions to patient care, which mirrors that the nurses have distinct areas of expertise and that each nurse's opinion and values regarding professionalism are reinforced. The subconstruct "communication and collaboration" indicates the capacity of nurses to supplement and balance each other and value their equality in regards to their relationships. The subconstruct "common goal" clarifies the mutual expectations regarding the nature of shared responsibilities and goals in patient care, which contribute to the positive outcome in reducing adverse events [27]. In addition, open discussions were held to solve differences related to the planning and conducting of patient care. The subconstruct "conflict management" has been described as an essential component of collaboration, as well as the ability to interact professionally, build and maintain interpersonal relationships and tackle conflicts, which are critical aspects of promoting collaboration while deterring hostility and uncooperative behaviors among nurses [19]. In the NNCB Scale, the items pertaining to negotiating resolution processes are essential in generating a mutually acceptable resolution, which is considered to be a key theoretical feature of collaboration [28,29].

5. Study limitations

The nurses who participated in the study were from a large hospital in Beijing and it important to keep in mind that thee results may therefore be different in other areas. The level of care should be taken into consideration when studying the nurse collaboration across different hospitals and wards, since collaboration within any ward is based upon the staff and their working habits [30]. Measuring collaboration therefore has its limits, however our study is unique in that it provides a novel way of measuring and evaluating nurse collaboration. This study also has a number of methodological weaknesses that should be taken into consideration when interpreting thesee results. The use of a convenience sample, as well as this study's small sample size, places significant limitations on the generalizability of these results. A formal confirmatory factor analysis should be performed to support the construct validity and determine whether the subscales accurately represent the domains of collaboration. This scale therefore requires further psychometric testing with a future goal of further instrument improvement.

6. Conclusion

This is the first instrument available that provides insight into the cooperation behavior among nurses. The scale developed here demonstrates acceptable validity and reliability. Its use on a broader scale would at least guide and promote collaborative relationships among nurses involved in patient care. Moreover, the information provided helps identify the extent of cooperativeness and the strength of interpersonal relationships among nurses. This provides the opportunity for clinical nursing managers and educators to create specific interventions to improve the level of cooperation between nurses, and to determine whether associations between a nurse's behavior, socio-demographics and professional practices play an important role. An important factor is to determine whether their quality of care, turnover and organizational training is associated with positive nurse–nurse relationships. If so, the scale would prove helpful in assessing the effectiveness of training programs and determining what kind of training program is the best fit to achieve better cooperativeness. Finally, the availability of the NNCB Scale will determine the factors that hinder or aid collaboration among countries and wards units.

Conflicts of interest

We declare no conflicts of interest with respect to the research and/or publication of this article.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ijnss.2015.10.005.

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